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THE
LARYNGOSCOPE.

VOL. LIII MAY, 1943. No. 5

A SIMPLIFIED OPERATION FOR BILATERAL ABDUCTOR PARALYSIS.*

DR. JULIUS W. MCCALL and DR. FREDERICK S. GARDINER,
Cleveland.

Laryngologists and thyroid surgeons alike owe a deep debt of gratitude to Dr. Brian King, of Spokane, and Dr. Joseph Kelly, of New York, for their pioneer work in relief of bilateral abductor paralysis.

Dr. King in his first report utilized the principle of substituting a viable muscle for a paralyzed one and, in this particular instance, attached the anterior belly of the omohyoid muscle to the muscular process of the arytenoid cartilage. He says, "When I first began to experiment with this problem it was on the theory that a sound muscle might be transposed to the arytenoid cartilage and subsequently develop a capacity to replace the function of the cricoarytenoideus posticus muscle. It was hoped that the cords could thus be opened on inspiration and allowed to close to the phonating position during relaxation of the transposed muscle. In cases of long standing bilateral paralysis, some new problems were encountered. So the operation that was conceived as a method of opening the cords by the use of an extraneous muscle in actuality developed into a new method of cord displacement."

Dr. King states that his first operative technique was based on the hypothesis that it would be an orthopedic procedure. This, he says, "in actuality developed into a new method of cord displacement." Dr. Kelly makes a window in the lower

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posterior third of the thyroid alae and removes the arytenoid cartilage. We do not believe an arytenoidectomy is necessary.

Dr. Joseph D. Kelly says, "In studying the larynx, we found that if a window were made in the lower posterior third

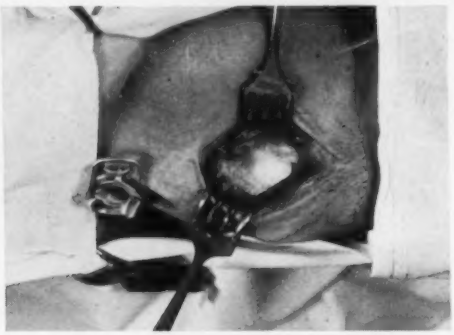

Fig. 1. Right thyroid alae exposed.

of the thyroid cartilage, with its anterior border limited by a line separating the middle and the posterior inferior third of the thyroid cartilage, we should come down on the muscular structure covering the arytenoid cartilage, and that by careful dissection the arytenoid cartilage could be removed with little damage to the intralaryngeal mucous membrane."

Fig. 2. Transillumination, right arytenoid through thyroid alae, using anterior commissure scope (time exposure).

Dr. Kelly in the above quotation reveals the varying relationship between the arytenoid cartilage and the outer surface of the thyroid alae in different larynges.

We offer the following simplification in the belief that it will be helpful to those doing surgery for the relief of bilateral abductor paralysis:

The operation should be done by a two-man team. One of them should be a trained laryngologist, familiar with the use of the laryngoscope and direct intralaryngeal manipulation. In any extralaryngeal operation for relief of bilateral abductor paralysis, the identification and fixation of the arytenoid cartilage is the alpha and omega of the procedure. Anyone who has done this operation realizes the greatly varying relationship between the arytenoid cartilage and the outer surface of the thyroid alae in different larynges.

Just where to make the window in the thyroid alae to expose the aryternoid cartilage is not easy. Our most common

Fig. 3. Showing skin clip fixed in arytenoid cartilage.

error was to make the window either inferior or anterior to the arytenoid cartilage. To overcome this uncertainty we have used the following procedure:

As soon as we have exposed the thyroid alae, a laryngoscope or, better still, an anterior commissure scope with a bright light is introduced in the usual manner. It is important to have the largest and brightest lamp the scope will carry with the battery turned on as high as the lamp will permit. The arytenoid is then engaged by the end of the laryngoscope and firmly pressed laterally against the thyroid alae. The room is then darkened, and it is an easy matter to

see just where the window in the thyroid alae should be made. In reality, it is a transillumination of the arytenoid cartilage through the thyroid alae.

The next most difficult step is fixation and presentation of the arytenoid cartilage through the window. To overcome this

Fig. 4. Arytenoid mobilized interarytenoideus muscle severed.

difficulty, the following procedure was perfected by us in the anatomical laboratory.

After the window is made in the thyroid alae, the laryngoscope is reintroduced in the larynx. A small full-curved

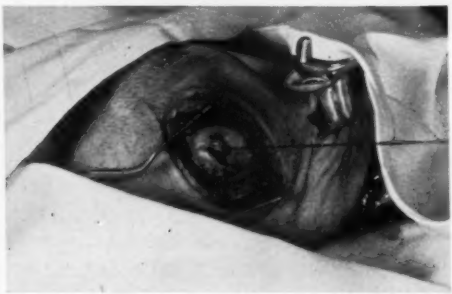

Fig. 5. Traction on suture delivering arytenoid cartilage into window of thyroid cartilage.

atraumatic needle or small skin slip with suture firmly tied in the center is fixed in the anterior portion of the arytenoid

cartilage at the cord attachment. The interarytenoideus muscle is then severed and the arytenoid cartilage is mobilized by disarticulating it from the cricoid cartilage. The end of the suture is then fed through the window and traction on the suture delivers the arytenoid cartilage into the window. After the arytenoid cartilage is delivered into the window of the thyroid alae, it should be anchored securely with 0.1 chromic gut.

1. The method described is simple and time-saving.

2. It eliminates the necessity for arytenoidectomy.

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610 Rose Building.

CANDY AND CHEWING GUM AS FOREIGN BODIES IN THE AIR PASSAGES.*

DR. PAUL H. HOLINGER, Chicago.

Hard candies, lozenges or chewing gum aspirated into the larynx, trachea or bronchi present specific foreign body problems. Children constantly place candies in their mouths while playing, and it can be easily understood that aspiration could take place during the rapid respiration that accompanies childhood activity. Similarly, chewing gum, so frequently present in the mouths of adults as well as of children, is chewed during all types of activity and inactivity. The adult who dozes with gum in his mouth or the child who goes to sleep with chewing gum in his mouth suggests the potential danger of this type of foreign body. The possibility of aspirating chewing gum is even greater during intense athletic activity. It is easy to conceive of a basketball player, for instance, aspirating the gum during a game, and many athletes do chew gum constantly while engaged in athletic activity.

A thorough review of the literature reveals only occasional mention of either candy or chewing gum as a foreign body in the tracheobronchial tree. Jackson and Jackson[1] do not record any such accident in their series of 3,266 cases. They have stated,[2] however, that they have had a number of cases in which candy caused bronchial obstruction but have not recorded them because on removal of the obstructing material there is no definite foreign body. The severe respiratory obstruction which chewing gum could produce was suggested by Tuohy and Pemberton.[3] In the instance they cite, one piece of chewing gum was found in the pyriform sinus and a second inside the glottis of a 9-year-old boy. A splenectomy had been done under general anesthesia, and the foreign body was found on exposing the larynx to aspirate it under direct vision.

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Five patients in whom confections caused severe obstruction to the airway have been observed. These are, of course, exclusive of cases of obstruction produced by nuts or nut candies. The essential clinical data of the cases are, briefly, as follows:

CASE REPORTS.

Case 1: M. S., female, age 9 months, developed a cough during the night, and her mother gave her a large, brown cough drop, which she attempted to chew. She suddenly choked on it, and her mother slapped her on the back, which seemed to relieve her somewhat. Her cough increased, and when she was first seen at the hospital two days later she had developed a temperature of 101.4°. At this time there were coarse inspiratory wheezes over both sides of the chest, with the trachea and heart definitely displaced to the right. The foreign body history was not obtained

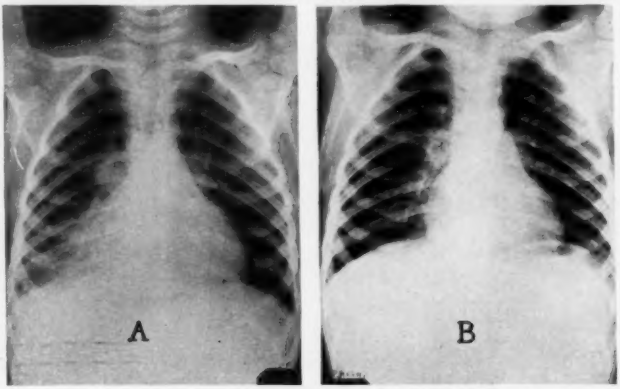

Fig. 1. Case 2. (A) Atelectasis of the right lower lobe following the aspiration of a "Root Beer Drop." (B) Chest X-ray following bronchoscopic aspiration.

at this time and the child presented a typical asthmatic appearance. She was discharged after responding satisfactorily to simple therapy. On returning a week later, the mother stated that the child had coughed constantly since the previous visit and that her breath had become foul. The child was observed in the hospital for 24 hours but was discharged as improved. A week later she was readmitted because of continued cough and the recurrence of many coarse rales and wheezes throughout the chest. Diminished breath sounds on the right and bronchial breathing in the left lower lobe, posteriorly, were found on physical examination. X-rays the previous week had shown patchy densities along the dependent bronchi of both lung fields. There was a lobular collapse along the right margin of the vertebral column causing displacement of the heart to the right, but a Roentgenogram taken during the second hospital admission failed to demonstrate this displacement. In view of the discrepancies between X-ray films, physical findings and clinical course, and because a more accurate history was now obtained, the child was re-examined fluoroscopically and a partial obstruction of the left main bronchus was demonstrated. The heart was in the normal position on inspiration but moved far to the right on expiration. This was recorded on inspiration and expiration films. The bronchoscopic exami-

nation revealed a large quantity of sticky, thick, brownish secretion in the left bronchus which was aspirated. The child made an uneventful recovery.

Case 2: K. D., age 5 years, male, was admitted to the hospital complaining of a constant cough accompanied by vomiting, which had been present day and night for one week. The onset had been sudden. No foreign body history could be obtained on admission. Because of the character of the cough, pertussis was suspected, although he had had pertussis three years previously. On physical examination the child did not appear to be acutely ill, but he had a peculiar, loose cough and his temperature was 100.2°. Physical examination revealed dulness over the right base, both anteriorly and posteriorly, suppression of breath sounds in this area, and many wheezes and coarse rales. The remainder of the physical findings were essentially negative. The red blood count was 5,350,000; the white blood count 10,600, of which 72 per cent were polymorphonuclears, 21 per cent lymphocytes, 3 per cent monocytes,

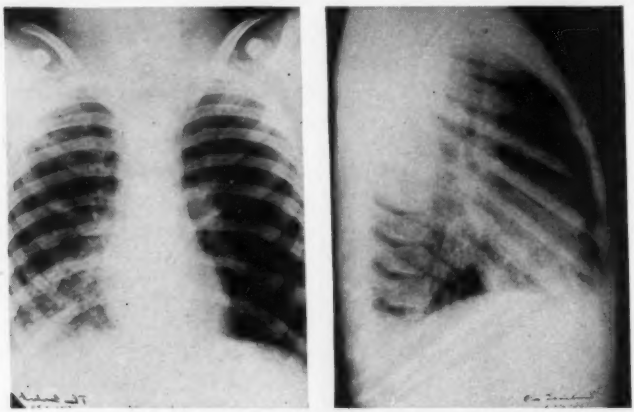

Fig. 2. Case 4. Anteroposterior and right lateral Roentgenograms of a 10-year-old boy who had choked on a cough drop. The patchy soft tissue densities along the course of the bronchovascular markings from the right hilum to the right base are significant.

3 per cent eosinophils and 1 per cent basophils. The X-ray report was as follows: "There are faint soft tissue densities along the course of the bronchovascular markings from the right hilum to the right base. This is almost the identical picture seen in previous cases where a thick, syrupy substance was aspirated." Further questioning of the parents revealed the fact that the boy had had a package of "Root Beer Drops" at the time of the first paroxysms of cough, and that he had told his mother he had "swallowed" one. These are hard, round candies, about 7 mm. in diameter. Physical findings of the chest remained unchanged for four days, and with the definite suggestion of a candy foreign body, both from the X-ray report and the parents' statement, examination of the tracheobronchial tree seemed indicated. The bronchoscopic picture was that of a moderately inflamed right bronchus obstructed by a large quantity of thick, tenacious, mucopurulent secretion. This was aspirated, leaving the bronchial lumen apparently unobstructed by thickened mucosa. The following day, auscultation revealed that air entered the right lower lobe satisfactorily, although dulness persisted for about a week, when physical as well as X-ray findings demonstrated that the lung had entirely re-expanded.

Case 3: E. S., male 5½ years of age. During the week prior to admission to the hospital this child had had a severe cold, for which he had been given large doses of paragoric and atropine. While eating some round, red candies two hours before admission, he choked on one of them. The choking lasted only a few minutes and he began breathing more easily, but he became markedly dyspneic and cyanotic an hour and a half later. Physical findings and fluoroscopy showed a complete atelectasis of the left lung. Because of the increasing dyspnea, a bronchoscopic examination was made immediately. A very large quantity of sticky, red secretion was found in the trachea and left bronchus which plugged the bronchoscope and aspirators. The child's condition improved during the bronchoscopy, as the secretion was being aspirated, and after removal of the tube the physical examination showed the heart to have returned to its normal position. The following day the physical findings of the chest were essentially negative except for a slight wheeze throughout. This disappeared after three days, and the child was discharged in good condition.

Case 4: N. G., male, age 10 years. Because of a cold and a cough, this boy was given a cough drop when he went to bed, 10 days prior to his admission to the hospital. He had a coughing spell shortly after taking the cough drop and stated that "the cough drop went down." The cough persisted, and the following day marked dulness was found in the right side of the chest, which continued to be present until admission. X-ray confirmed the diagnosis of atelectasis of the right lower lobe. A very thick, tenacious, sweet-smelling secretion was found in the right bronchus, completely obstructing the lumen. Because of its tenacity, it was aspirated with difficulty. The child felt immediate relief, stating he could breathe more easily, but some sticky rales persisted, and a second bronchoscopic aspiration was made one week later. The temperature returned to normal following this second examination, but physical findings continued, although to a lesser degree, for several weeks, when they gradually disappeared.

Case 5: J. J., a 9-year-old boy, a patient in the hospital because of a peculiar deformity of the vertebrae,[4] had just finished Sunday dinner and was chewing gum and joking with other boys in the ward in the excitement preceding visiting hours. His vertebral deformity necessitated a complete body cast and he was lying on his back. Suddenly, while laughing, he choked and became extremely dyspneic and cyanotic. Oxygen gave little relief and artificial respiration was impossible until the cast was cut away. An immediate bronchoscopic examination revealed the chewing gum at the bifurcation of the trachea. Because it adhered to the walls of the trachea and to the carina, it could not be removed in one piece, and consequently some difficulty was encountered in re-establishing the airway. The gum likewise adhered to the walls of the bronchoscope, and each grasp of the foreign body with forceps resulted only in removal of very small pieces of gum between the blades and rendered the forceps useless for a second grasp because the sticky material would not allow the forceps to expand. The airway was eventually re-established, however, and the patient made an uneventful recovery.

DISCUSSION.

From the cases cited, it is apparent that occasionally candy can enter the air passages to cause laryngeal, tracheal or bronchial obstruction. The history of choking while eating candy is extremely important in establishing the diagnosis. Physical findings vary with the position of the obstructing candy and will change as the candy dissolves and produces atelectasis. In one of the cases presented (Case 1), this fre-

quent change, so characteristic of foreign bodies in the tracheobronchial tree, accounted for the failure to recognize the etiology and thus delayed bronchoscopy.

The Roentgenograms in these cases are fairly characteristic. Early, there is an obstructive emphysema on the involved side which soon is replaced by an atelectasis as the candy dissolves. This particular type of atelectasis manifests itself by peculiar patchy densities throughout the involved lobe. The area is obliterated by fine linear markings rather than the homogeneous density characteristic of postoperative atelectasis.

Obstruction of the bronchus may occur in one of two ways: *1.* the actual mass of the candy itself mechanically obstructs the airway; *2.* after entrance of the candy into the tracheobronchial tree, the irritation of its presence quickly causes a large amount of secretion to be poured into the obstructed bronchus. Within a relatively short time the candy is dissolved, forming such a thick, viscid solution that complete obstruction of the bronchus follows. This secretion resembles that found in postoperative massive collapse of the lung and produces physical findings identical to those of massive collapse. It might even be suggested that certain persistent cases of so-called unresolved or atypical pneumonia in children with thick, purulent sputum and areas of patchy atelectasis may originate in such foreign body accidents.

SUMMARY.

Hard candies and chewing gum occasionally become foreign bodies in the lower respiratory tract. A positive history with physical findings of laryngeal, tracheal or bronchial obstruction establishes the diagnosis. Roentgen findings of bronchial obstruction or a peculiar patchy linear atelectasis are diagnotic aids. The possibility that some of the otherwise unexplained atelectases that occur in children may be due to the aspiration of hard candies while the child is playing must be considered.

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A FEW HINTS AND SURGICAL DETAILS IN RHINOPLASTY.*

DR. G. AUFRICHT, New York.

The general technical approach and the great variety of possibilities in corrective rhinoplastic surgery are today well known facts in the medical profession. It is also known that rhinoplasty, comparatively speaking, is not a new surgical science, nor does it need any more the acid test of time. Its existence and development are closely connected with the name of Prof. Joseph, father of modern rhinoplastic surgery, who began his work as early as 1888. By the early part of this century his methods were recognized as classic procedure and are considered as such now. A number of other prominent pioneers, independently or inspired by Joseph's work, have advanced techniques differing from that of Joseph. Time and experience, however, lead the majority of surgeons to an appreciation of Joseph's basic methods.

Plastic surgery has had its interesting strides and experiences in taking its place among the other recognized specialties.

It is beyond the scope of this paper to dwell on the different stages of this development. Before commencing the objective part of my presentation, however, permit me to mention briefly the preliminary considerations involved before a rhinoplastic change is undertaken. Prior to deciding the advisability of a correction, the normal physiology or absence of pathology must be established and the patient's mental attitude toward the deformity evaluated. The balance between the extent of the deformity and the sensitiveness toward it must be noted and caution observed if it is out of proportion.

After the surgeon has established his "esthetic diagnosis" of a detractive nose, his next step is to study the face and visualize an improved substitute. This is followed by the anatomical analysis of the deformity. The extent of every

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anatomical constituent in causing the deformity must be established. Are the nasal bones too prominently developed? Are the upper lateral cartilages extremely large or is only their position faulty? Are the tip cartilages large, in a faulty position, or both? Does the septum take part in causing the deformity? A clear analysis is necessary in planning the correction.

The proper technical approach, while important, is far from sufficient. One must possess a definite esthetic sense to decide the extent of the desired change. Beyond the esthetic judgment, structural visualization of the anatomical architecture is essential. While the knowledge of anatomy, physiology and surgery of the nose is *sine qua non*, the artistic creative power is the most important factor in the success of the operation. We so often see results which while very satisfactory from the surgical point of view are still unsatisfactory to the patient and observer.

This esthetic sense can be developed with training and experience if there is an inborn foundation for it; if not, it is as futile as attempting to make a musician of one who is tone deaf.

As far as the technique is concerned, there are a great variety of procedures which are helpful in the solution of the desired changes. The basic principles are outlined by Joseph's classic methods, but there are many little details and individual experiences which are helpful. There is no foolproof method which will assure the success of the change. Experience, judgment, constructive ingenuity, improvisation are necessary to meet the variety of problems. Permit me to present a few details which have been helpful in my experience in rhinoplastic surgery.

PHOTOGRAPHIC RECORD.

Today in surgery and medicine the importance of the photographic record is recognized; in no department are photographs of such importance as in plastic surgery. Their value is manifold: *1.* as a record they are more easily and quickly comprehensible than a written description of the deformity; *2.* they are the best means of comparison between pre- and postoperative conditions; *3.* they serve to remind patients of

the original appearance, which is often forgotten; and 4. they are at times indispensable for medicolegal purposes.

Another merit in possessing photographs is that they are most useful in the study of the deformity. One can also draw diagrams on the photographs. During the operation, the photographs should be placed in the operating room in a position easily visible to the surgeons, as they are helpful as a guide when the contours are obscured by infiltration and edema. Finally, the photographs are valuable in teaching and for illustrating purposes in publication, to prove the value of the surgical procedure.

I should like to make a few recommendations and suggestions as to standardization of photographs. Eight standard

Fig. 1. Standard set of preoperative photographs, comprising same views in repose and laughing.

pictures should be taken routinely of every patient; front view, both profiles, and one nostril picture from beneath; one set with the patient in repose and one with the patient laughing (see Fig. 1). Additional views are, in certain cases, of importance. For instance, lateral protrusions or depressions of the dorsum are shown best in three-quarter profile.

The importance of the laughing pictures should not be underestimated, because often deformities are obvious or exaggerated only during laughing. During laughter the relation of the tip of the nose to the dorsum changes. The tip of the nose and columella are pulled down, exaggerating any prominence or convexity of the dorsum. The alae nasi become distended and are pulled upward by the elevating muscles of the cheek. Sometimes an otherwise straight nose can show a

hump, especially a cartilaginous hump, when the patient laughs; or a normal length nose can show a drooping tip. Laughing often exaggerates a short upper lip, which is caused by the extreme downward protrusion of the septal cartilage. Such an upper lip, crowded by the nose, will break in a transverse fold when the patient laughs. In some cases laughing is done under a strain, in order to protect the nostrils from spreading.

Frequently a self-conscious expression betrays a patient's sensitiveness about the deformity. Very often the patient himself wishes to call the attention of the surgeon to the particular expression on his face which he considers objectionable; sometimes he grins, sometimes frowns, sometimes distends the nostrils and at other times absorbs the nostrils to exaggerate the deformity and call the surgeon's attention to it. It would be interesting to record the changes during many additional emotions but it is not practicable; laughing is the most important.

The profile picture should show, against a black background, the silhouette of the face, set at a right angle to the camera. The head should be held perfectly level; bending down or raising it might lengthen or shorten the appearance of the nose. At an oblique angle, the nose is apt to look foreshortened.

The lighting effect should be such as to bring out all the contours in their natural proportion; an especially grave mistake is to use a different lighting in the pre-and postoperative views. Before- and after-pictures should be taken under identical lighting conditions, because light effects can exaggerate or diminish deformities. A special lighting effect is permitted occasionally to bring out certain deformities; for instance, a lateral twist of the dorsum will show better with a sharp light on one side of the face and a shadow on the other. Or the depth of a saddle-nose will be more apparent with lighting from above or below, so that the shadow thrown on the saddle will make the depression more conspicuous. In these cases, however, it is our duty to demonstrate the postoperative views with the same lighting effect.

The size of the photographs should be the same, preferably fairly large (four by six inches). Neither the film nor the print should ever be retouched.

I bring these suggestions before the members of this Section, who, I am sure, strive for an improvement of standards, in the hope of increasing the value of photographic illustration and of helping to avoid unintentional misrepresentation of the result of the operative procedure. It would be a definite step forward if the profession and the publishers could be impressed that in scientific literature and demonstrations, standard views should be insisted upon.

DIAGRAMMATIC MARKINGS ON THE SKIN OF THE NOSE AND THEIR VALUE DURING NASAL PLASTIC OPERATION.

The importance of analysis of a nasal deformity and the planning of the correction cannot be overestimated. Any effort that a surgeon may apply to assist him in this study

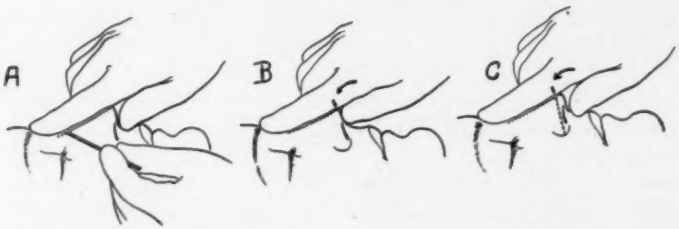

Fig. 2. Diagrammatic markings on nose. (A) New profile line is marked on the skin. (B) Tip of nose pressed with thumb and desired position marked on glove of index finger (follow arrow). (C) Pressure with thumb on tip of nose released. Mark from index finger transferred to nose (follow arrow). Area included between dotted line and border of columella indicates extent of correction.

is well spent. Joseph, many years ago, constructed a profilometer, with which he measured the angle of the profile of the nose. Moulages, plaster casts, drawings, et cetera, have been recommended and used.

In my practice I have found extremely valuable a simple diagrammatic procedure which I execute directly on the skin of the nose at the time of the operation. I draw the diagrams of the planned contours on the skin of the nose with mercurochrome or methylene blue. This diagrammatic procedure is executed in the following manner:

After the patient has been draped and before the novocaine is injected, the right index finger is placed on the side of the dorsum so that the tip of the finger rests at the radix nasi (see Fig. 2). In such a manner the new profile line can

be visualized and marked. With the index finger held in the same position, the tip of the nose is raised with the thumb, so the desired shortening may be visualized. On the glove of the index finger the planned shortening is marked with a dot. Then the pressure on the tip is released, and the mark on the index finger is transferred to the skin of the relaxed nose. This point is connected with the base of the ala by a line. The triangle between the vertical line and the end of the nose indicates the extent of the proposed shortening.

It must be realized that the diagrammatic measurements on the skin of the nose are not constant during the operation, for the skin will be distorted soon after the infiltration of novocain and when the edema sets in; furthermore, the rela-

Fig. 3. Diagrammatic marking for correction of nasal tip. Dotted line marks center of tip. Lower transverse lines mark margin of tip cartilages. Upper transverse lines, starting from dotted line, divide tip cartilages into upper and lower field. Vertical parallel lines indicate segment to be excised for correction.

tive position of the diagram will change again when the skin is undermined and part of the dorsum resected.

Nevertheless, the diagrammatic planning is of definite value. First, it gives added opportunity to study the deformity, and the amount of tissues to be removed. Second, with the diagram shown, one absorbs into the fingertips with careful palpation the dimensions of the dorsal deformity. The most important landmark for the sense of touch is the radix nasi. The relation between the depth of the radix nasi and the plane of the new profile is memorized in the fingertips.

Following the same principle, diagrammatic planning is used on the tip of the nose. The following landmarks are drawn for the remodeling of the tip (see Fig. 3). First, the center of the tip is marked, then the midline of each half. With transverse markings the tip is divided into an upper and a lower field. The upper field includes the undesirable convexity of the tip. In the lower field, a vertical segment is

outlined, the like of which is to be excised from the cartilages. The margin of the lower lateral cartilage is also marked.

After infiltration, one finds it impossible to follow the diagram as an absolute guide. I wish to stress again that the real value of these diagrams lies in the opportunity to study and memorize the dimensions before the operation.

NEW METHOD FOR NARROWING THE BONY DORSUM.

After nasal plastic operations, no matter how gratifying the new profile line to both surgeon and patient, one often sees the unsatisfactory sequel of a conspicuously wide bony dorsum and radix nasi. This has been one of the ever-present problems in rhinoplastic surgery.

It is a known fact that after the bony hump has been removed, the bridge of the nose becomes wide, due to the gap between the resected edges of the nasal bones. In cross-section of the nose one virtually removes the apex of a triangle, the base of which rests on the plane of the maxilla. According to Joseph's technique, to overcome the secondary deformity of a wide bridge, the frontal processes are sawed off from the maxilla, and then the entire bony side of the nose is *infractured* and placed toward the center. This procedure will have the effect that the gap between the resected edges of the bones will be closed, which will result in a narrower dorsum.

According to Joseph's technique, the infracturing of the bony side of the nose after it has been sawed off from the maxilla is done either with the pressure of the thumb or by more violent methods, such as hammering over a specially designed metal bar, the "rhinoclast," or other hard substances.

It is a common experience that the bony side of the nose, instead of being fractured off or disarticulated in one piece at its junction with the frontal bone, will break somewhere in its upper third; at times a sharp spicule will remain firmly attached to the radix nasi (see Fig. 4). The bony side often breaks in more than one place, causing a comminuted fracture. The most disappointing experience, however, is that even after the bony sides have been completely disarticulated from their frontal attachment and have been pressed toward the center, the dorsum will still remain wide.

These undesirable effects have a definite anatomical and physical reason. The best approach to the problem is first to realize that the anatomical characteristic of the bony dorsum and the radix nasi are entirely different. The bony dorsum is a thin, hollow structure; the radix nasi is massive and solid. A brief survey of the structure of the nose will clarify the reasons for the difficulties encountered.

The bony dorsum is formed by the ossa nasalia. The os nasale is a longitudinal, quadrangular bone, thick and narrow at the upper end, thin and broad at the lower. The two nasal bones form an arch over the nasal cavity. Their thick upper

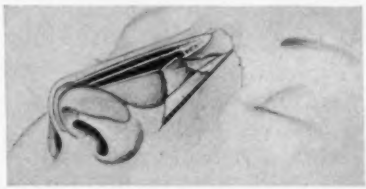

Fig. 4. Typical fractures occurring with method of "infracturing" bony sides of nose to narrow the dorsum. Notice massive bony web and radix nasi resisting fracture.

ends join the frontal bone at the nasofrontal suture-line, constituting the radix nasi; they rest in a niche formed by the pars nasalis of the frontal bone, and on the downward protruding spina frontalis. In addition to the more massive formation of the upper ends of the nasal bones, this sheltered position and the support of the sturdy spina frontalis are responsible for the outstanding strength of the radix nasi. The thin lower part of the nasal bone is convex like a shell. Laterally, the nasal bone joins the frontal process of the maxilla and forms with it the side of the nose. The frontal process is the direct continuation of the maxilla; the upper end is dovetailed into the frontal bone side by side with the os nasale.

After this anatomical consideration, it must be realized that the resection of an average sized hump from a nose with normal subglabellar indentation involves mainly the lower, thin part of the nasal bones. Little or nothing is resected from the thick, upper part; moreover, the radix nasi is usually not affected at all (see Fig. 4). There is a gap created between the resected edges of the nasal bones. At the upper

part of the dorsum, however, a bony web remains even after resection. This bony web, which may be thicker or thinner, forms a physical obstacle to the infracturing procedure.

Recognizing this physical condition, I have attacked the problem of fracturing the bony sides differently from Joseph. First, instead of fracturing the nose inward from without, I fracture it in the reverse direction — outward from within. With "outfracturing" there is less resistance to overcome, and there is more room for levering. Second, I divide the existing bony connection at the radix nasi. Third, I remove the bony web from within the dorsum, and a corresponding segment from the radix nasi when necessary.

The technique of "outfracturing" is simple. It can be done with a strong pair of scissors, or an osteotome, or with a chisel. The scissors or the osteotome is employed in such a

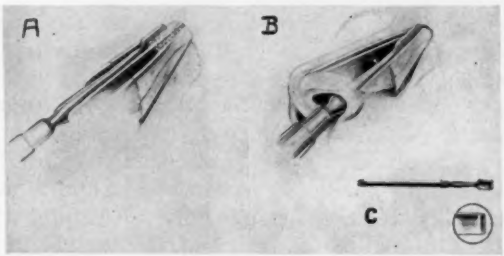

Fig. 5. "Outfracturing technique." (A) Chisel in situ cutting through bony web of nasal bridge and radix nasi after hump has been resected. Dotted lines indicate segment to be removed from bony web and radix nasi. (B) Bony side of nose "outfractured" with chisel. (C) Bone chisel. Inset shows rounded corners.

manner that the upper blade is placed above the dorsum, the lower in the nasal cavity below. They are held close to the septum and with moderate force the remnant of the bridge and the radix nasi are cut through, and the nasal bone (together with the frontal process) is forced outward in one piece. When the chisel is used, it is introduced between the nasal bone and the septum (see Fig. 5). With a few light taps of the hammer, the radix nasi is cut through, then the bony side is moved outward, the chisel levering from the frontal bone. After being so mobilized, the bony side can be pressed inward with ease.

If a voluminous web is present between the nasal bones, or the radix nasi is too wide for the proportions of the new nose,

a strip of bone has to be resected, either with a chisel or bone punch. I use a special chisel with a long flat blade and rounded blunt corners, in order to prevent injury to the skin (see Fig. 5c). The chisel is introduced in the space between the septum and the nasal bone; it is first held close to the lateral wall, which is broken off with a few light taps of the hammer. Then the chisel is placed medially, close to the septum, and a longitudinal strip of bone is chiseled off, partly from the web and partly from the radix nasi (see Fig. 5a). The same procedure is carried out on both sides. The bony strips are then removed with a Kelly clamp. In this manner the bony side of the nose is not only mobilized but can actually be placed nearer to the septum throughout its entire length. Formerly, a considerable force had to be exerted; by this method, a light pressure of the finger is sufficient to press the bony side toward the center.

It is obvious that in order to achieve a thorough narrowing of the dorsum, other minor obstacles must also be removed. The redundant mucous lining on both sides of the septum must be trimmed at the resection edge; and if necessary the same should be done to the mucous lining of the resected nasal bones, in order that soft parts should not interpose and interfere with the narrowing. The sawdust and debris which might settle between the nasal fragments is carefully removed with a curette. A high deviation of the septum interfering with the central placement of the nasal bones must be corrected.

If there is no hump to be resected, but only a wide bony dorsum to be narrowed, without the necessity of changing the profile line, the same principles are followed. First in order, the base of the frontal process is sawed off. Then a strip is resected from each nasal bone near the midline throughout its entire length. Afterward the entire bony side is easily moved toward the center.

After the operation is completed, a dental molding wax cast is applied for one week, to maintain the narrowed position of the dorsum. The dental molding wax cast is especially advantageous because it can be snugly fitted to hold the radix nasi in the proper position during the healing.

An added advantage of this technique is that it eliminates

in many cases the necessity for after-treatment with Joseph's nasal clamp.

SHAPING THE NOSTRIL AND THE ALAR ATTACHMENT.

Details of the remodeled nose are often responsible for its success or failure. Large nostrils, flaring alae, bulging base of the nostril, ill direction of the alae are the most common

Fig. 6. Different types of nostrils.

shortcomings of the corrected nose. A patient upon whom I performed a successful rhinoplasty in July, 1932, insisted upon further correction on the fleshy basal attachment of the alae. The size of the nostrils were already reduced by Jos-

Fig. 7. The nostril and its boundaries.

eph's triangular excision to the minimum it could afford. Weir's method of semilunar excision at the alar fold was not applicable either. After studying the case thoroughly, in

June, 1934, I excised an inverted prism-shaped piece from the basal attachment of the ala with its apex toward the nostril and base toward the cheek; in such manner I succeeded in

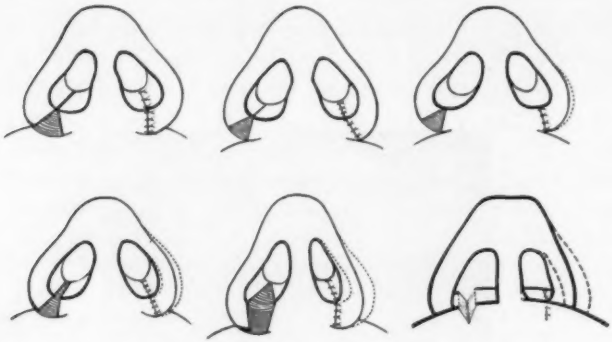

Fig. 8. Diagrams of a few typical excisions from base of the right nostril and ala; effect indicated on left nostril.

reducing the fleshy attachment of the nasal wing without decreasing the size of the nostril or vestibulum itself.

Commencing with this operation, a great variety of excisions and corrections at the base of the nostril followed.

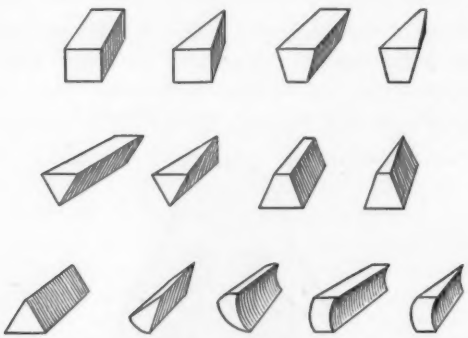

Fig. 9. Typical geometrical forms excised from lower border of nostril and ala.

From this time on, the photographs of the nostril became part of the standard photographic set. Fig. 6 shows a group of different types of nostrils.

The shape of the nostril is dependent upon its boundaries

(see Fig. 7). The deciding factors are the tip of the nose above, the columella medially, the basal ridge (if absent, the upper lip) below, and the ala laterally. By the excision of a great variety of geometrical forms from the base of the nostril, the attachment of the ala, or the ala itself, practically all related deformities can be met (see Fig. 8). The geometri-

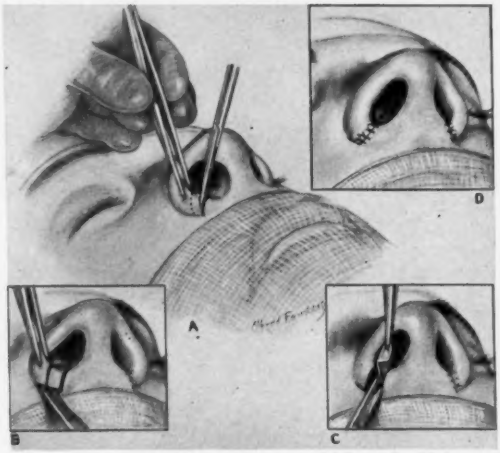

Fig. 10. (A, B and C) Excision from lower border of right nostril. (D) Reconstructed base of nostril and vestibulum.

cal forms range from a prism to an uneven cuboid of any size (see Fig. 9). The excised geometrical pieces may be of even thickness throughout or may be broad at the outer margin and taper off toward the vestibulum. It might include the full thickness of the ala or save the vestibular lining if there is an indication for it. With the excision of an uneven piece it is possible to change the direction of the ala. An inverted ala can be everted and vice versa; a hanging ala can be raised, a high ala lowered. There is no end to the possibilities, the description of which would be too voluminous and unnecessary once the principle is appreciated. Fig. 10 shows the principle of the operative procedure.

I have had the pleasure of demonstrating this little surgical procedure to many observers since 1934, and also presented it before the annual meeting of the American Society of Plastic and Reconstructive Surgery in 1939. It has since become a standard procedure with many surgeons.

RECONSTRUCTING THE ARCH BETWEEN THE CRUS MEDIALE AND THE CRUS LATERALE OF THE LOWER LATERAL CARTILAGES.

A sharp, narrow tip of the nose is a deformity which often gives an undesirable expression. The cause of this is naturally the anatomical formation of the tip cartilages. Normally they form a gently curved arch where the crus laterale and the crus mediale meet (see Fig. 11a). If, instead of this convexity, the crura meet in a sharp angle, they cause a pointed tip (see Fig 11b).

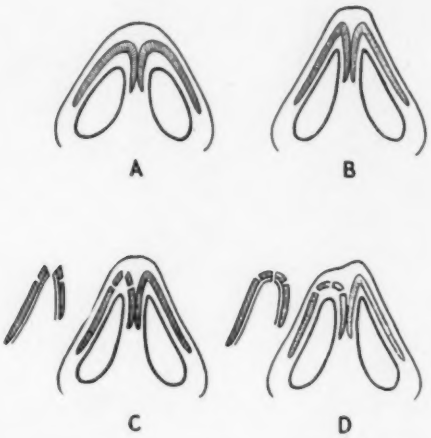

Fig. 11. (A) Diagram showing normal convexity of lower lateral cartilages. (B) Pointed lower lateral cartilages found in too narrow tip. (C) Lower lateral cartilages divided at highest point; cartilaginous segments prepared on both crura, cutaneous lining intact. (D) Cartilaginous segments in new position to reconstruct normal convexity.

A little surgical procedure is helpful in overcoming this deformity. First, the skin is undermined from an incision near the inner margin of the nostril, then the tip cartilage is divided at its highest point, separating the crus mediale from the crus laterale (see Fig. 11c). The division may or may not include the cutaneous lining. Now cartilaginous segments are cut at the ends of the crura in such manner that they shall remain attached to the underlying skin lining. These mobile segments of the crura will bend downward, and are left to heal in a position imitating the convexity of the normal arch (see Fig. 11d). This position is assured by careful support with vaseline gauze packing.

This operation is also applicable where a prominent tip has to be reduced, and for this purpose the crown of the arch of the tip cartilage has to be resected. If the free ends of the crura were left to heal together in a point, the tip might become too narrow.

A reversed procedure, quite similar in principle, is applied when a broad, receding tip is to be advanced.

SUBMERGED SUTURE, USED IN FORMING THE NASOLABIAL ANGLE.

A rather well known deformity or configuration is when the columella and upper lip do not meet in a definite angle,

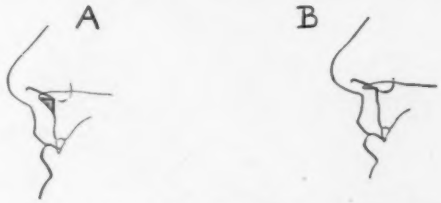

Fig. 12. Nasolabial web. Absence of nasolabial angle.

but are bridged over by a slanting web. The cause is usually a prominent inferior nasal spine or a protruding septal cartilage (see Fig. 12a).

To correct this deformity, Joseph, after removing part of the inferior nasal spine (see Fig. 12b) and a portion of the protruding septal cartilage, placed two heavy mattress sutures through the columella at the point of the desired angle. Even if left only 24 to 48 hours, these sutures often caused superficial necrosis followed by scars. To overcome the danger of scar formation at the base of the columella, I use a subcutaneous suturing technique which holds the angle in place without any pressure on the skin.

The technique is as follows: First, the needle is put through the septum opposite the nasolabial angle. It then enters through one side of the columella in the direction of a point in the center of the columella exactly where the labiocolumellar angle is supposed to be. Here the needle emerges through the skin (see Fig. 13a). The needle is then reintroduced through the same point where it emerged, and is carried toward the other side of the columella (see Fig. 13b).

Thus, while the damage to the skin is not more than a needle hole, the columella is held firmly in the desired angle (see Fig. 13c).

THE USE OF CELLOPHANE IN STRAPPING THE TIP OF THE NOSE.

Plastic surgery of the tip of the nose is one of the most intricate phases of rhinoplasty. The architecture of the frail lower lateral cartilages offers many problems. The shape of the tip often gives that finishing touch which makes the difference between a good or mediocre result.

The remodeling of the lower lateral cartilages entails a change in their size, shape and position. To achieve these

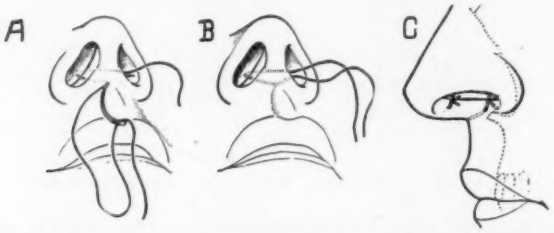

Fig. 13. Submerging suture to form nasolabial angle. (A) Mattress suture holding columella to septum emerged through skin; needle entering through same hole to complete suture. (B) Mattress suture completed, except tying it. (C) Suture completed holding nasolabial angle. Dotted line, at nasolabial angle, indicates amount of tissue embraced subcutaneously.

changes, the crura usually have to be separated and remain suspended only by the surrounding soft tissues. During the postoperative edematous stage, their position is very insecure unless fixed by splint or strapping.

Fixation is one of the most important steps in the plastic of the tip.

Joseph, who did not apply any fixation, used to say that one can observe two different results after remodeling the tip: *1.* the immediate result; and *2.* the late result. He realized that the final result was obscured for weeks and months by the postoperative swelling and that after the edema subsided there was always somewhat of a chance as to what position the crura would settle into. The delicate cartilages are easily dislocated by a blood clot or edema and frequently heal in a faulty position, causing a wider tip than expected, a groove

in the tip, assymetry between the two sides, or distortion of the alae and nostrils.

It has always been our ambition to eliminate this element of uncertainty. It is my belief that this has been achieved by the adhesive strapping of the tip, which procedure I have used since 1927* (see Fig. 14).

The strapping must not be too tight. If it is it will cut into the skin, causing conspicuous scars. A few such tragic

Fig. 14. Adhesive strapping for tip of nose to immobilize remodeled lower lateral cartilages.

results have come to my attention from different sources. To overcome this danger of strangulation, as well as to apply a more accurate strapping under direct observation, I have substituted transparent adhesive cellophane tape for the regular adhesive. This material was submitted to me about 11 years ago by a cellophane merchandising official for experimentation. It can be sterilized in an autoclave without losing its adhesive qualities. I now regularly use the Scotch tape for this purpose.

The chief advantage in its use is that one can observe the condition of the skin, the exact shape of the tip and the position of the alae nasi. There is always the chance that, if pulled too tightly, there may be a little folding of the skin, or the upper part of the nostril may be fixed in a faulty position, facts which would be hidden and consequently unremedied if regular adhesive tape is used. By the use of cellophane, one may observe not only faulty position, but ischemia which

*Aufricht, Gustave: Dental Molding Compound Cast and Adhesive Strapping in Rhinoplastic Surgical Procedure. Arch. Otol., 32:333, Aug., 1940.

might eventually lead to necrosis. Its application is similar to that of the regular adhesive tape (see Fig. 15).

THE USE OF TUBING WITH NASAL PACKING.

The next suggestion is an improved method of packing following rhinoplasty. The packing of the nose after the operation is important and has several purposes. It prevents contamination; its slight pressure against the incision seals

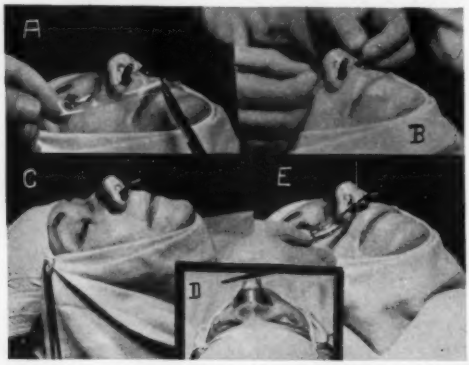

Fig. 15. Supportive strapping for tip of nose with adhesive cellophane. (Previous to strapping, nose is packed with vaseline gauze around tubes.) (A) Strip of cellophane cut. (B) Cellophane placed at base of tip. (C and D) Cellophane transversely across tip. (E) Cellophane strapping completed; hardly noticeable due to its transparency.

the wound, preventing copious bleeding; it prevents adhesion of opposing wounds; and finally, its most important function is giving support to the reconstructed anatomical parts.

The light vaseline packing in the vestibulum supports the reconstructed tip. The anatomical parts are firmly held between the packing from beneath and the strapping from above. One can observe the adhering quality of the vaseline gauze as soon as the packing is in the vestibulum. The loose skin of the remodeled tip recedes readily to its new form. Negative pressure in the vestibulum may play a part in this phenomenon. Early removal of the packing often starts bleeding; furthermore, it deprives the reconstructed nose of the desired support.

The longer the packing is kept in the nose the better it is for the wound healing and from the esthetic point of view; however, there are some well known dangers and disadvan-

tages in keeping it in too long. Aside from the discomfort, there are the dangers of lack of ventilation and drainage. To overcome these, I use Dakin tubes near the floor of the nose and apply the packing around them (see Fig. 16). While not entirely sufficient for breathing, the patient is relieved of the choking sensation, dry mouth and throat, and pressure in the ears upon swallowing, usually experienced with packing.

The packing, in combination with the rubber tubes, may be left in place for three or four days; if necessary, a week. After the submucous resection of a severely deviated septum,

Fig. 16. (A) Breathing tube at the floor of nose. (B) Photographs showing tubes in nostrils; silk suture through tubes safeguards them from slipping back into nose. (C) Cast and dressing completed after operation. Ends of tubes emerge from gauze dressing.

the mucous flaps or mobilized cartilages can be forced to heal in the corrected straight position by leaving the packing in long enough. After such a long time, it can usually be easily removed without bleeding; neither are the passages immediately clogged as is frequently the case after early removal. The tubes may be flushed several times daily with metaphedrine oil or other disinfectants.

Instead of a rubber tube, the same of metal or other material, similar in size to the Dakin tube, may be used. These may be cleaned and resterilized.

103 East 86th Street.

FREE SKIN GRAFTS AND PEDICLE FLAPS IN THE TREATMENT OF RECURRING BASAL CELL EPITHELIOMAS. CASE REPORTS.*

DR. D. F. WEAVER, Detroit.

Basal cell epitheliomas are usually slow growing and do not metastasize; therefore, their early treatment by adequate surgical measures is followed by complete freedom from recurrence and absence of deformity in a very high percentage of cases. Blair, Moore and Byars[5] report equally good results from irradiation. Not infrequently, however, we are called upon to treat cases of long standing which, due to inadequate surgical or irradiation measures, have continued to progress. Frequently the underlying periosteum or perichondrium is involved, and this makes successful eradication by irradiation unlikely. It is felt that some type of surgical removal is the method of choice in these cases. There is usually a certain degree of deformity already existing as a result of the tumor itself, and adequate surgical removal or the destruction of the lesion by use of surgical diathermy usually results in additional immediate deformity; however, by the use of free skin grafts and pedicle flaps, the ultimate cosmetic result is usually satisfactory. One wishes to produce as little deformity as possible, of course, but this should always be considered secondary to complete eradication of the tumor.

Immediately following removal of the tumor, frozen sections are examined microscopically, and if one can be reasonably sure that none of the tumor cells remain, a free skin graft may be applied immediately. In certain of these cases, a pedicle flap may be more suitable. If, however, there is doubt about having removed the entire tumor, or if perichondrium or periosteum are found to be involved, it is well to thoroughly electrocoagulate the involved area by the use of surgical diathermy, and wait for separation of the slough, which usually requires three to four weeks. New[1], Figi and Havens state if bone is cauterized to any degree, or is left

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open for a number of weeks, it will be necessary to remove a sequestrum in most cases. About two months following the cauterization is usually the optimum time for removal of this sequestrum.

When the cranial vault is involved, Straith[2] has advocated the boring of holes in the outer plate in order to allow granulation tissue to come through. After these wounds have been

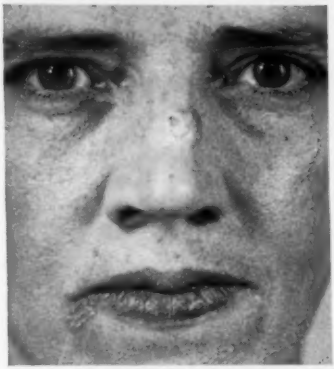

Fig. 1a. Before operation.

covered by granulation tissue, it is usually advisable to cover them with a free skin graft or a pedicle flap. The choice of a particular kind of graft or flap depends on a number of factors and since this subject has been so thoroughly covered by numerous textbooks and other publications, I shall not discuss the subject in detail at this time (Barsky[3] and Figi[4]). The following cases illustrate some of the above principles.

Case 1: A white woman, age 36 years, was examined on Aug. 19, 1941. She stated that in 1929 she had had a lesion burned from the dorsum of her nose by the use of an acid. In 1931 it had recurred, and she had had irradiation by the use of radium. This was followed by regression of the tumor and a moderate amount of scarring. There was no further evidence of tumor until in 1939 when it recurred. It continued to grow steadily.

On examination of the nose an elevated tumor of about 1 cm. in diameter was seen on the dorsum of the nose, overlying the lower end of the left lateral nasal cartilage and the upper edge of the left alar cartilage. There was moderate scarring of the nose on the right side of the tumor (see Fig. 1a). A small biopsy was taken, which proved to be a basal cell epithelioma. The remainder of the ear, nose and throat examination was negative. General physical examination was found to be negative except for a slightly elevated blood pressure of 140/90. Examination of the urine was negative. Hemoglobin was 13 gm. white blood cells, 6,000; the Kline exclusion test was negative.

On Sept. 15, 1941, using 1 per cent novocaine anesthesia, the lesion was excised. A portion of the subcutaneous tissue, muscle and cartilage immediately beneath it was included in the excision. At one point an area 4 or 5 mm. in diameter, consisting of only nasal mucous membrane, remained. Following the examination of several frozen sections, the pathologist stated that the margin was adequate in all sections studied, and that the cartilage was apparently not involved. Bleeding was controlled by ligatures of fine linen and a full thickness skin graft dissected from the right postauricular region was sutured in place with interrupted silk sutures, which were left long and tied over gauze to maintain firm, even pressure. This dressing was removed on the tenth postoperative day and a light pressure dressing applied for several days longer. Fig. 1b shows the result on the fifteenth postoperative day. Since the lesion had been treated previously with radium, and since, due to its location, it was reasonable to suspect that the cartilage might be involved, it was felt that any less radical method of treatment would not have been advisable. Nineteen months later there was no evidence of recurrence.

Case 2: A 45-year-old man of Russian birth presented himself at the Henry Ford Hospital on Oct. 4, 1940. He stated that in 1932 he first noticed a tumor behind his right ear. It felt firm and nodular to him and

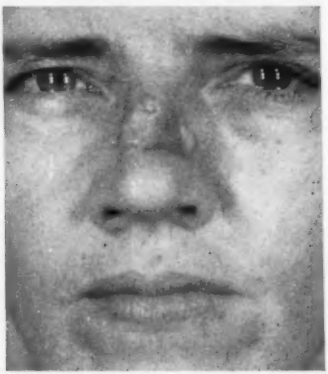

Fig. 1b. Fifteenth postoperative day.

during the following four or five years it had become ulcerated on two occasions. The last time the ulcer had not healed. In 1939, one year before admission, an operation was performed for its removal by a surgeon in his locality. The wound failed to heal following this operation, and it was treated locally for a number of months with no improvement.

On examination, a rather deep ulcer about 3½ cm. in diameter was found in the right postauricular region. The edges of the ulcer were heaped up and there was evidence of a firm tumor surounding the ulcer on all sides, extending well up into and involving the lobe of the ear. There appeared to be a moderate inflammatory reaction present (see Fig. 2a). A small biopsy removed from the edge of the ulcer proved to be basal cell epithelioma. The tonsils were found to be chronically infected, and a subacute nasal infection was present which had followed a cold he had contracted a week or 10 days previously. No significant abnormalities were found on general physical examination. Blood pressure was 132/80. Urine was negative. Hemoglobin was 14 gm.; white blood cells, 5,550; the Kline exclusion test was negative. The nasal infec-

tion was treated until it cleared up, and during this time continuous warm, moist compresses were applied to the right postauricular region in an effort to clear up the infection in the tumor.

On Oct. 14, 1940, under 1 per cent novocaine infiltration anesthesia, care being taken not to allow the needle to penetrate the region of the tumor, the entire involved area was excised with surgical diathermy,

Fig. 2a. Before operation.

using the cutting current. This included the lobule of the ear and the depth of the ulcer. Immediate examination of frozen sections showed an adequate margin on all sides, but there was not sufficient margin in the depth. Immediately beneath the depth of the involved area lay the mastoid tip, the facial nerve, the parotid sheath and, deeper, the great ves-

Fig. 2b. Granulating wound about three weeks after destruction of lesion.

sels of the neck. The entire area was thoroughly electrocoagulated and left open. At one time during the procedure, there was a twitch of the face due to stimulation of a branch of the facial nerve, but there was apparently no injury. His temperature ranged between 99° and 100.8°

Fahrenheit for about three days, and then remained normal. He was discharged from the hospital on the seventh postoperative day.

On Nov. 1 the wound was well covered by clean granulation tissue (see Fig. 2b). Several biopsies were taken and found to be free of tumor. On Nov. 4, 1940, under 1 per cent novocaine infiltration anesthesia, the skin of the ear stump was freed up and closed. An intermediate skin graft was then removed from the inner aspect of the right thigh and applied to the area. Interrupted silk sutures were used, left long and tied over gauze to maintain firm, even pressure. The teeth were wired together in order to immobilize the lower jaw, and the neck was immobilized by use of adhesive tape. The temperature remained normal, but on the seventh postoperative day there was slight odor and discharge from the dressing. The dressing was removed, and it was found that the graft was in excellent shape and the drainage was coming from the ear stump. Warm, moist compresses were applied and recovery was complete. Fig. 2c shows the result three weeks after operation.

One year after operation there was no evidence of recurrence of the tumor. In order to replace the lobule, it will be necessary to use a pedicle

Fig. 2c. Three weeks after application of graft.

flap, but due to personal reasons the patient is not interested in having that done at the present time.

Case 3: A 52-year-old man of Scotch birth was examined on July 19, 1941. There was a history of having been struck on the forehead by an angle iron in March, 1931. Some debris was removed at the time, and for a number of months the wound would first heal slowly and then break open. In 1933 the entire area was excised and the skin closed. Microscopic examination of the tissue removed at that time proved it to be basal cell epithelioma. The wound remained healed until in 1937 when the tumor recurred and was excised again. In 1939 there was another excision of a recurrence of the tumor. Following this, rather intensive irradiation with radium and X-ray was given. The general health had remained good throughout.

On physical examination there was found to be a lesion in the center of the forehead which appeared to be neoplasm and was apparently fixed to the periosteum. This lesion appeared to be only a few millimeters in diameter but was surrounded on all sides by unhealthy appearing skin. The skin was thin and pale, and there was evidence of considerable scarring. This area measured 4 x 2½ cm. and extended well down over

the bregma (see Fig. 3a). The remainder of the ear, nose and throat examination was negative. General physical examination was negative. Blood pressure was 138/76. Urine was negative. The hemoglobin was 11.5 gm. The white blood cells were 5,900, and the Kline exclusion test negative.

On July 21, 1941, under local infiltration with 1 per cent novocaine, the area of tumor and abnormal appearing skin was widely excised.

Fig. 3a. Before operation.

Immediate examination of frozen sections of the tumor showed rather widespread invasion by the basal cell epithelioma. The underlying bone and soft tissues were thoroughly electrocoagulated with surgical diathermy. The slough separated in a few weeks and there was a rather large area of exposed bone over the right frontal sinus (see Fig. 3b).

Fig. 3b. Three weeks after destruction of lesion.

Roentgenograms showed the sinus to be rather large. On Sept. 8, 1941, under intravenous pentothal sodium anesthesia, a survey flap was elevated from the left side of the forehead with the pedicle extending beyond the midline on the right. A flap with the pedicle high in the scalp could not be used because the denuded area extended low enough so that such a flap would not cover it without too much tension. The free end of the flap was lined with an intermediate free skin graft from the inner aspect of the right upper arm. This lining was the width of the

flap and about two inches long. The flap was sutured back into its original bed.

A small area of the devitalized anterior wall of the frontal sinus was removed, exposing a large frontal sinus with markedly hypertrophied mucous membrane. The remainder of the sequestrum was not removed at this time. On Sept. 22, 1941, under local and block anesthesia with 1 per cent novocaine, the entire sequestrum was removed and the thickened membrane removed from the sinus. The frontonasal duct was large and appeared to be adequate. The edges of the skin around the wound were freshened and the lined pedicle flap was transferred to the defect. The lining of the flap was patterned to fit the normal periosteum and sutured to it with fine catgut sutures. The flap was then sutured

Fig. 3c. Appearance soon after final operation.

in place with silk sutures and the bed from which the flap had been removed was covered with two intermediate free skin grafts from the inner aspect of the right thigh. These grafts were sutured together with silk. The dressing was removed from the grafts on the tenth postoperative day and they had taken well.

The frontonasal duct proved inadequate and the secretion from the lining drained to the outside for a number of weeks. Since healing was otherwise complete, the patient continued to work during this time.

On Feb. 6, 1942, under infiltration anesthesia using 1 per cent novocaine, a portion of the lined flap was elevated. The frontal sinus was found to be completely filled by firm fibrous tissue, so, although it had been originally planned to enlarge the frontonasal duct, it was decided to remove the lining and apply the flap directly to the fibrous tissue which filled the sinus. Fig. 3c shows the patient at the time of his dismissal when there was no evidence of drainage and healing was quite complete. Fourteen months later the patient was free of symptoms and there was no evidence of recurrence.

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SOME FACTORS INVOLVED IN THE DEVELOPMENT OF OTOSCLEROSIS.*

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Otosclerosis is perhaps the most discussed disease of the ear. The etiology of the infection is as yet undetermined; even the morphology is not quite clear, and we are as helpless as ever respecting effective means of treatment.

In order that the development of otosclerosis may be understood, a thorough knowledge of both the embryology and morphology of the otic capsule and of the pathology and symptomatology of otosclerosis is essential. Without pretending to go into details I should like to emphasize the principal points relating to the otosclerotic process. First, the otic capsule has achieved its adult form at birth, and consists of three layers, of which the middle layer, developed from cartilage, retains areas of immature tissue (cartilage islands) throughout life, while the other two layers are of membranous origin and become solid bone. As a result of this early retardation in growth and the presence of remnants of immature tissue, the bony otic capsule differs from all other bones in the body. Second, otosclerosis is a disease of the otic capsule exclusively with its primary focus centralized in the enchondral layer at its immature zones. Histologically, the disease is characterized during its progressive stage by large marrow spaces of an embryonal type and by a high degree of vascularity. Clinically, classic otosclerosis is characterized by symptoms of a disturbance in conduction.

The factors described as causes for the development of otosclerosis may be grouped as local environmental, *i.e.*, in the otic capsule itself, and as general environmental, outside of the otic capsule. Under the heading, local environmental, we may include trauma and inflammation. General environmental factors are either physiologic (puberty, puerperium, pregnancy) or pathologic (disturbance of the general metabolism)

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diseases which are accompanied by high temperatures and excessive physical or mental activity.

All investigators admit that the cause advanced in their respective theories must be considered as a secondary one acting on a point of innate weakness of the otic capsule. What the primary factor may be has not been determined, and in the search for effective means of treatment for the disease most emphasis has been concentrated on counteracting the secondary factors; also, most of the investigators noticed the high vascularization of the otosclerotic foci at certain stages of their growth. In the last years the surgical procedure involving fenestration of the labyrinth, inaugurated by Holmgren, Sourdille and Bárány, has been improved by Lempert. As in the case of the more conservative methods, this surgical procedure is symptomatic only and may not be considered as effecting a cure. At this point I would like to mention the new theory of Bast regarding the fissula ante fenestram and the relation of this structure to otosclerosis and to the fenestration of the labyrinth. The fissula ante fenestram is a constant structure in front of the oval window in man, composed of immature tissue. Bast observed endothelial-lined channels in this structure which connects the perilymphatic tissue of the vestibularic end with the mucoperiosteal layer of the tympanic end. This would suggest the possibility that the fissula ante fenestram is a perilymph filtering structure. If the fissula is a drainage area for perilymph, its obliteration, which occurs occasionally in otosclerosis, would result in stagnation of the perilymph. Fenestration would re-establish perilymph drainage.

With the aforementioned facts in mind, Siebenmann, as early as 1897, expressed the opinion that this disease represents a renewed activity and a continuation of the normally interrupted complete change of cartilage in the course of ossification of the labyrinthine capsule. Politzer classified it as a disease *sui generis* of the otic capsule. Bast believes that otosclerosis represents a late attempt at rebuilding of bone in unstable regions of the labyrinthine capsule.

Alexander holds the point of view that highly vascularized foci in the temporal bone of the newborn child, even of the embryo, represents the initial stage in the disease.

Wilson regards this area in the otic capsule as being in a

state of disequilibrium and believes the appearance of dilated vessels may indicate that the vascular factor plays an important rôle in the otosclerotic process.

Guggenheim, in 1935, regarded the problem from a philosophical point of view. He considers otosclerosis as a condition of regression in which the genes of regression become predominant. Thus the tendency toward a closure of the otic capsule is created, resulting in a condition similar to that seen in the otic capsules of lower animals in which normally no windows are present.

While I am not going to discuss the numerous theories, I would like only to call attention again to those facts which in my opinion seem to form a complete chain in the whole problem. The otic capsule does not change after birth and contains in its enchondral layer immature tissue throughout life. In young otosclerotic foci we find many newly formed marrow spaces and engorged blood vessels, while the immature tissue has disappeared, to be replaced later by newly formed irregular bone. Since the transformation of cartilage into bone depends upon the activity of the blood vessels, we may assume that at birth, in the zones where cartilage islands are normally present, these blood vessels have been obliterated and, therefore, have lost their capacity to transform the cartilage rests into bone. It seems reasonable that the same forces which normally are concerned with bone formation may act on this immature tissue under certain conditions in *later life*. It is possible that in some individuals certain of these numerous blood vessels which normally are obliterated fail to undergo such change and continue to transform the cartilaginous elements into bone. The ultimate result of this process would be the complete ossification of the otic capsule, a condition which actually occurs in some cases of otosclerosis. At the beginning the local metabolism evidently is very low, and the foci grow very slowly, producing neither subjective nor objective symptoms. If later on secondary factors, either pathologic or physiologic, come into play, they serve as a stimulus toward increased activity of the otosclerotic process and the disease becomes clinically manifest. In most instances otosclerosis is diagnosed at puberty, but the precipitating influence may be found also in violent exercise, preg-

nancy, the puerperium, all diseases which are accompanied by high temperatures, disturbed general basal metabolism, etc.

In my opinion otosclerosis is an abnormality in the development of the otic capsule. This abnormality has its basis in the continued presence of blood vessels which in the normal course of development would have been obliterated. In other respects capsular development would be essentially if not entirely normal. On this basis the disease would be regarded as a continuation of growth beyond normal limits. Slow at the onset, growth of the otosclerotic process is accelerated by the introduction of secondary factors.

I am fully aware that this theory at present is somewhat theoretical and has to be supported by the investigation of temporal bones of newborn children of otosclerotic descent. In order to obtain the material, the co-operation of otologists, practitioners and gynecologists is necessary. My case at this time rests on the investigation of normal human embryos and fetuses, on clinical observation in numerous otosclerotic patients, and on the microscopical examination of temporal bones obtained from cases of adult otosclerosis. I am unable to offer suggestions for the effective treatment of the disease, but it is possible that ligation of some afferent blood vessels, as Wittmaack has suggested in his theory of stasis and halisteresis, might be worthy of trial. The use of X-ray under controlled conditions might be beneficial.

INCIDENCE AND PERMANENCY OF TONAL DIPS IN CHILDREN.*†

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The present study, based on the audiometric examinations made of school children for another investigation,[1,2] reports: *1.* the incidence of "Tonal Dips" in 1,365 children; and *2.* the degree of permanency of the dips in 493 children whose hearing was repeatedly examined during a two-year period. Previous studies have been primarily about dips in adults, and although some of the reports include a small number of children, none gives either the incidence of dips or their characteristics in childhood; furthermore, because they are based on single examinations, previous reports record only the incidence of dips and do not include information with respect to their permanency. It is usually assumed that dips either persist as dips or progress to an impairment of hearing for all high tones. The records of the repeated examinations show clearly that a tonal dip, at least in a child, is not necessarily permanent.

The incidence of tonal dips in any collection of records of hearing acuity is to a considerable degree affected by the definition of a dip that is employed. For the present paper the minimum requirements for classification as a dip at any of the frequencies from 512 to 4,096 cycles per second, inclusive, differ slightly from those for dips at the higher and lower frequencies.‡ For the range 512 to 4,096 cycles it is required that the local tonal depression be at least 15 decibels (dcb.) below the neighboring tones and 15 dcb. or more below the average of the audiogram. For frequencies higher than 4,096 cycles (or lower than 512 cycles) the threshold for the next higher (or lower) tone has to be at least 20 dcb. better than the dip-frequency, providing that the average line of the audiogram or the 20 dcb.-line of the chart is not reached by

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‡The criteria of what constitutes a dip will be discussed in a later paper.

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the neighboring tone. Most of the dips of this material are of such a degree that there can be no doubt of their nature.

Calibration of the audiometer and reliability of the patients' responses are also factors that affect the incidence of dips. That the calibration of the audiometer was correct is proved by the fact that other children examined the same day had normal thresholds for the frequency. Reliability of responses can, of course, always be questioned, but it seems unlikely that on rechecking thresholds during the test and also on re-examinations at another date lapses of attention occurred for the same frequency. The effect of this factor has been further reduced in the present study by exclusion of records whose reliability was questioned by the examiner at the time the hearing test was made.

During the school year 1939-1940, careful hearing tests were made of 1,365 Baltimore school children from 8 to 14 years of age (672 boys and 693 girls). A Western Electric Co. 1-A audiometer was used in a soundproof room and the thresholds were determined for 14 frequencies, namely: 32, 64, 128, 256, 512, 1,024, 2,048, 2,896, 4096, 5,793, 10,321, 13,004 and 16,384 cycles per second. During the two years following the first examination the hearing tests were repeated periodically for 493 of these children (297 boys and 196 girls). Irradiation, with radon, of hyperplastic lymphoid tissue in the nasopharynx was given to 156 children (116 boys and 40 girls). The other children did not receive any kind of treatment.

The incidence of dips at the first examinations of the 1,365 children is shown in Table 1. The more striking facts revealed by this table are: *1.* Dips occur three times as often in boys as in girls (15 and 5 per cent of the ears, respectively); *2.* dips occur more often in the older children of both sexes than in the younger ones; *3.* dips occur at the frequency of 4,096 cycles more than three times as often as at any other frequency; and *4.* dips that include more than one frequency are of rare occurrence in girls but constitute one-fifth of the dips in boys.

Although dips occur much more often in boys than in girls, the proportion of "4,096 dips" to all dips is about the same (somewhat more than half) in both sexes. In the girls none of the 4,096 dips includes either of the frequencies a half-

octave higher or lower, but in the boys there are 34 "wide" 4,096 dips and 81 dips limited to this frequency only.

For the 493 children who were re-examined five or more times in two years, the incidence of dips at the first examination is shown in Table 2 (Column A of each subgroup). The proportion of these re-examined children who had dips when first examined is slightly greater than in the total material, but the age and sex differences are similar. For each subgroup of Table 2, Column B gives the total number of dips observed at all examinations, including the first. (A dip at

Table 1. The number of tonal dips, at different frequencies, in the audiograms of first examination of 672 boys and 693 girls.

Frequency	Boys		Girls		All Boys	All Girls
	8-10	11-14	8-10	11-14		
2,048	2	6	2		8	2
2,896	1				1	
4,096	31	50	18	19	81	37
5,793	4	11		1	15	1
8,192	9	15	2	5	24	7
10,321	5	13	4	4	18	8
13,004	7	5	5	6	12	11
2,048-4,096	1	4			5	
2,896-4,096	4	2			6	
2,896-5,793		1			1	
4,096-5,793	8	12			20	
4,096-8,192		2			2	
5,793-8,192	1	2			3	
5,793-10,321	1	1			2	
8,192-10,321		2	1	1	2	2
8,192-13,004				1		1
10,321-13,004	1	1			2	
Total No. of Dips	75	127	32	37	202	69
Total No. of Ears	658	686	756	630	1,344	1,386
Per Cent of Ears with Tonal Dips	11.4	18.5	4.2	5.9	15.0	5.0

any frequency is counted but once, even if present at all examinations.) Numerically the increase in dips during the period of observation is greater in the boys, but in proportion to the number of dips at the first examination the increase is greater in the girls. For the boys the ratio is somewhat less than two to one, for the girls somewhat more than three to one. The greatest increase, numerically and proportionally, and for both sexes, is for the frequency of 10,321 cycles. The least proportional increase is for 4,096, the frequency at which dips were present most often at the first examination. The differences in incidence of new dips during the period of observation are large enough to be definitely significant and are therefore further analyzed.

Table 2. The number of tonal dips, at different frequencies, in the 297 boys and 196 girls whose hearing was examined five or more times during a two-year period of observation. For each subgroup of the table, Column A gives the number of dips at the first examination, and Column B the total number of dips observed at all examinations, including the first. The records of treated and untreated children are combined in this table.

Frequency	Boys, 8-10		Boys, 11-14		Girls, 8-10		Girls, 11-14		All Boys		All Girls	
	A	B	A	B	A	B	A	B	A	B	A	B
2,048		2	5	8		3			5	10		3
4,096	18	22	24	35	13	16	4	5	42	57	17	21
5,793	2	7	9	16			1	2	11	23	1	2
8,192	5	8	11	25		8	1	3	16	33	1	11
10,321	3	21	8	31		19	2	10	11	52	2	29
13,004	6	7	2	5	1	5	2	4	8	12	3	9
2,048-2,896				1						1		
2,048-4,096	1	2	1	1					2	3		
2,896-4,096	1	1	1	2		1			2	3		
4,096-5793	8	10	5	6					13	16		1
5,793-8,192			2	4					2	4		
5,793-10,321	1	1	1	1					2	2		
8,192-10,321			2	6		3			2	6		3
8,192-13,004		1								1		
10,321-13,004				1				1		1		1
Total No. of Dips	45	82	71	142	14	55	10	25	116	224	24	80
Total No. of Ears	276		318		236		156		594		392	
Per Cent of Ears with Tonal Dips	16.3	29.6	22.3	44 6	5.9	23 3	6.4	16.0	19.5	37.7	6.1	20.4

Inspection of the records of the repeated hearing tests shows that the tonal dips in this material differ with respect to permanency in ways that may be grouped under the descriptive terms: persistent, recurrent, temporary-persistent and temporary. Dips that were present each time the hearing was tested after the dips were first noted are classified as persistent, irrespective of whether or not the amount of the dip remained stationary. The classification recurrent is used for dips which were present at an earlier test, disappeared at one or more examinations and later reappeared at the same frequency as in the earlier tests. In several cases there was more than one recurrence of a dip during the period of observation. A dip is called temporary-persistent if it was present at two or more consecutive tests, then disappeared and did not recur by the end of the period of observation. The term temporary is used for dips that were present at one examination only. It is realized, of course, that if the period of observation had been longer or if hearing tests had been made more often, the classification of some of the dips would be different.

Section I of Table 3 shows the degree of permanency of the dips that were present at the first examination, Section II shows the same for the new dips that appeared during the period of observation, and Section III gives the totals. The lower lines of the table give the percentages of dips with respect to the total number of ears of boys and of girls, respectively.

Of the total number of dips present at the first examination, about two-fifths (39 and 38 per cent, respectively, for boys and for girls) proved to be persistent. New dips appeared during the period of observation in 18.2 per cent of the ears of boys and in 14.3 per cent of the ears of girls. Of these new dips, 22 per cent of those in boys and 7 per cent of those in girls proved to be persistent. Since at the first examination the boys had a threefold greater incidence of dips than the girls, the increase in the number of persistent dips is about the same in both sexes, roughly 50 per cent. In the boys the increase in persistent dips was mostly for the frequencies of 10,321 and 4,096 (eight and six new persistent dips, respectively), but in the girls none of the new dips at these frequencies proved to be persistent.

Temporary dips account for 70 per cent of the new dips

Table 3. The degree of permanency of the tonal dips observed in the audiograms of the 297 boys and 196 girls whose hearing was examined five or more times during a two-year period. The nonpersistent dips (Other Dips) are classified as Recurrent (Rec.), Temporary-Persistent (T.-P.) and Temporary (Temp.). Subdivision I shows what later happened to the dips present at the first examination, Subdivision II gives the corresponding information for dips not observed until after the first examination, and Subdivision III the totals for all dips recorded during the period of observation.

Frequency	Sex	I					II					III				
		Persis. Dips	Other Dips	Subgroups of Other Dips			Persis. Dips	Other Dips	Subgroups of Other Dips			Persis Dips	Other Dips	Subgroups of Other Dips		
				Rec.	T.-P.	Temp.			Rec.	T.-P.	Temp.			Rec.	T.-P.	Temp.
13,004	Boys		8	2	1	5		4	2	1	1		12	4	2	6
	Girls	1	2	1	1			6			6	1	8	1	1	6
10,321	Boys	4	7	1	4	2	8	33	6	6	21	12	40	7	10	23
	Girls		2			2		27	3	4	20		29	3	4	22
8,192	Boys	5	11	5	4	2	2	15	3	2	10	7	26	8	6	12
	Girls		1	1				10	1	2	7		11	2	2	7
5,793	Boys	3	8	4	4		2	10	5	1	4	5	18	9	5	4
	Girls		1	1				1	1				2	2		
4,096	Boys	16	26	12	8	6	6	9	1	4	4	22	35	13	12	10
	Girls	8	9	5	1	3		4	1		3	8	13	6	1	6
4,096-5,793	Boys	9	4	2	1	1	2	1		1		11	5	2	2	1
	Girls							1			1		1			1
2,048-4,096	Boys	4						2	2			4	2	2		
2,896-4,096	Girls															
Dips at Other Frequencies	Boys	4	7	4	3		4	10	6	1	3	8	17	10	4	3
	Girls						4	3			3	4	3			3
Totals	Boys	45	71	30	25	16	24	84	25	16	43	69	155	55	41	59
	Girls	9	15	8	2	5	4	52	6	6	40	13	67	14	8	45
Per Cent of Ears with Tonal Dips	Boys	7.6	11.9	5.0	4.2	2.7	4.0	14.1	4.2	2.7	7.2	11.6	26.1	9.3	6.9	9.9
	Girls	2.3	3.8	2.0	0.5	1.3	1.0	13.3	1.5	1.5	10.2	3.3	17.1	3.6	2.0	11.5

in the girls and 40 per cent of those in the boys, and, in reversal to the usual sex difference, the absolute incidence of new temporary dips was greater in girls than in boys (10.2 and 7.2 per cent, respectively). For both sexes most of the new dips that proved to be temporary were for the frequencies above 5,793, the largest number was for 10,321. For new dips classified as recurrent and as temporary-persistent, the largest numbers were also for the frequency of 10,321 cycles per second.

At the first examination (see Section I of Table 3) eight of the nine dips that proved to be persistent in the girls were for the frequency of 4,096; no new persistent dips at this frequency appeared in the girls during the period of observation. In the boys, 45 of the dips present at the first examination proved to be persistent and 16 of these were for the frequency of 4,096; six new persistent dips at this frequency appeared during the period of observation.

Except for persistent dips, the actual numbers and the percentages given in Section III (totals) of the table are, of course, greater than would be found at examination at any particular date, because the figures include all temporary and recurrent dips that appeared at any time during the period of observation.

More than three-fourths of the persistent dips showed fluctuations of 10 dcb. or more during the period of observation. A progressive increase in the sharply localized dips occurred in 16 cases, and a "widening" of the dips to include adjacent frequencies occurred in eight cases. Three dips had a progressive decrease in the amount of the localized impairment, and two originally "wide" dips became "narrower."

In 41 instances, a dip present in earlier audiograms was not apparent during a temporary impairment for all high tones, but was again noticeable when improvement for the other high tones occurred. In some of these cases the actual thresholds of the frequency of the dip itself remained stationary.

No significant correlation was found between the occurrence of tonal dips and any of the following items: previous tonsillectomy and adenoidectomy, history of otitis media, attacks of common colds, the appearance of the tympanic

membrane, the condition of the nasopharynx or the season of the year.

DISCUSSION.

From the present study it is evident that the sex difference in the incidence of tonal dips in children is fully as marked as others have reported for adults. The most common hypothesis that has been advanced to explain the greater incidence of dips in adult males is prolonged exposure to industrial noise. Ciocco,[3] for instance, wrote: "It may be a true sexual difference, but on the other hand it must be remembered that the male patients who comprise our material are for the most part laborers whose several occupations may have exposed them in many instances to injurious noises; correspondingly, the females are, in general, housewives and have led a more sheltered life." Exposure to industrial noises certainly cannot explain the greater incidence of dips in boys than in girls; furthermore, other hypothetical explanations of dips — such as arteriosclerotic or arteriolarsclerotic vessels, toxic effects of alcohol, nicotine, etc. — do not apply to children. The most plausible explanation of the greater incidence of tonal dips in boys than in girls is that there exists a true sex difference. No evidence is available that would warrant a conclusion as to how sex exerts its effect on hearing, whether by a direct action of hormones on some part of the ear, whether by making the ear more susceptible in males than in females to similar noxious factors or by other hypothetical means.

The observations reported above also show that age is a factor in the incidence of tonal dips; at the first examination the older children of each sex had more dips than the younger ones, and the same children two years later had more dips than when first examined. Such an effect of ageing in children is, of course, to be expected, since whatever the cause of the dips, the older the child the more opportunity there has been for the development of causative lesions. In older people, the effect of ageing is to decrease the incidence of dips, because the development of impaired hearing for all high tones "smooths out" the dips present at an earlier age.

The incidence of dips in any series of examinations is, of course, affected by the number of tones for which thresholds are determined. In the present study, if thresholds had been determined only for octave intervals to 8,192 cycles instead of for the series of frequencies actually used, the incidence of

dips at the first examination would have been 9 instead of 15 per cent in the boys, and in the girls, 2.9 instead of 5 per cent.

The usual assumption has been that all dips in adults are persistent, that they increase progressively and that they are caused by cochlear lesions. Repeated examinations over a period of years have not been made in adults with tonal dips, therefore the assumption is unwarranted. Dips caused by cochlear lesions will, of course, persist and probably progress. It may well be, however, that a dip found in a clinical examination of an adult belongs to one of the types classified above as temporary, recurrent or temporary-persistent. The cause of such a dip must be a reversible lesion, the most probable location of which is in the conductive mechanism. In support of this view is the fact that, in a previous investigation,[4] temporary dips were caused by experimental alteration of the air pressure in the middle ear. Also, temporary dips have been observed by the author in patients with acute catarrhal otitis media. Histologic evidence that many tonal dips are not caused by cochlear lesions is afforded by Wever's[5] report from this laboratory. Serial sections of 51 ears with localized impairments for the frequency of 4,096 cycles were examined; the majority did not reveal circumscribed cochlear lesions that would account for the dips.

From the observations recorded for a two-year period, it appears that "wide" dips at 4,096 are more likely to be persistent than are those localized to this frequency only, and that the latter, in turn, are more likely to prove persisent than are dips at frequencies higher than 4,096 cycles.

SUMMARY AND CONCLUSIONS.

The incidence of "tonal dips" in 1,365 school children, 8 to 14 years of age, also the degree of permanency of the dips in 493 of these children whose hearing was repeatedly examined during the next two years is reported. Thresholds were determined for 14 frequencies beween 32 and 16,384 cycles per second, using a Western Electric Co. 1-A audiometer in a soundproof room. It was found that dips occur about three times as often in boys as in girls, and that for both sexes the older children have more dips than the younger ones. About half of all dips were for the frequency of 4,096 cycles per second.

Industrial noise, regarded by many as an important factor in the greater incidence of tonal dips in men than in women, does not explain the similar difference in boys and girls. The most plausible explanation is a true sex difference.

With respect to permanency of dips, the repeated examinations show that at least four classifications must be made, namely: persistent, temporary, recurrent and temporary-persistent.

Persistent dips were found most often for the frequency of 4,096 cycles, and temporary dips most often for 10,321 cycles. During the two-year period of observation, the greater increase in the number of dips, for both sexes, was at the frequency of 10,321 cycles. About two-fifths of all dips proved to be persistent. The observations indicate that "wide" dips at 4,096 are more likely to be persistent than are those localized to this frequency only, and that the latter, in turn, are more likely to prove persistent than are dips at frequencies higher than 4,096 cycles.

The classification of a dip cannot be determined from a single test of a child's hearing. This is doubtless true for adults also, and it may well be that many dips found at clinical examinations and regarded as caused by a cochlear lesion are in reality transient dips caused by a reversible lesion, probably in the conductive mechanism.

Relationships were sought, but not found, between the tonal dips in children and any of the following items: previous tonsillectomy and adenoidectomy, history of otitis media, attacks of common colds, the appearance of the tympanic membrane, the condition of the nasopharynx or the season of the year.

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THE INTRANASAL APPROACH TO THE LACRIMAL SAC.

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The intranasal operation on the lacrimal sac has been the centre of much interest, and there is considerable literature on the subject; however, the problem of intranasal dacryocystorhinostomy has not been solved. Not only ophthalmologists but also many otolaryngologists prefer the external dacryocystorhinostomy operation. Shambaugh,[1] for instance, suggests that it is quicker to perform and is less delicate than the intranasal method. Many other writers on the subject (Mundt,[2] Blue[3]) are also of the opinion that intranasal dacryocystotomy is difficult and not what one might call a perfect operation. The author's personal investigations show that in the majority of the leading European clinics external dacryocystotomy (Toti, Toti-Mosher,[4] Dupuy-Dutemps, etc.) is more frequently used than the intranasal method. This can be explained largely by the fact that ophthalmologists prefer the latter method. It also can be accounted for by the fact that only a few who possess the perfect technique of intranasal dacryocystotomy frequently apply it. With the majority, the operation is not common as it is considered too delicate and under unfavorable anatomical conditions is difficult to perform.

There is, however, quite a simple way, even with unfavorable anatomical conditions, to approach the lacrimal sac and to free it widely and create good drainage from it into the nasal cavity. This method was first applied by I. Veis[5] and consists of a channel through the lateral nasal wall from the pyriform aperture to the lacrimal sac. This original method, also used by Orembovsky,[6] Claus,[7] Marschik[8] and Gumpertz,[9] has been modified by the author, in that the bone is removed more radically so that the lacrimal sac is completely freed. Experience has shown that, in spite of the liberal removal of bone, external disfiguration does not result. The lacrimal sac lies on the frontal process of the superior maxilla and the

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lacrimal bone. It is very easy to reach the sac from the outside but it may be very difficult to create a large and convenient communication with the nasal cavity. The small opening through the lacrimal bone and the posterior part of the frontal process of the superior maxilla does not allow good inspection of the complicated structure of the nasal cavity. The intranasal approach to the lacrimal sac creates a good condition in the nasal cavity for permanent drainage but it is very difficult by this means to locate the lacrimal sac. The topographical relations between the sac and the inferior

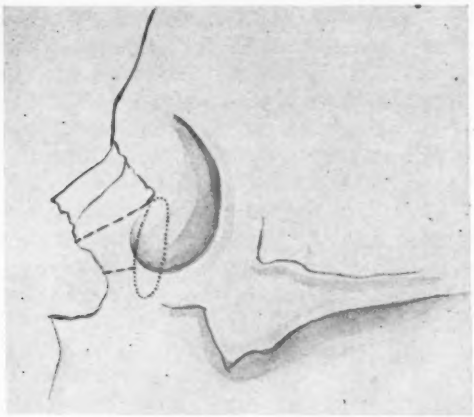

Fig. 1. View of bony nasal structure from the left. The dotted line indicates position of lacrimal sac. Broken lines indicate the bony section which must be removed.

and middle turbinate bones are very inconstant. The transapertural method described here avoids this inconvenience and gives a sure approach to the lacrimal sac (see Figs. 1 and 2) because it removes all the bone lying in front of the sac.

TECHNIQUE.

Half an hour before the operation the patient is given an injection of morphine or some other anesthetic. The operation is much simplified if the patient is placed in a semirecumbent position with the head inclined backwards. The front half of the nasal cavity and the middle meatus are painted with a cocaine-adrenalin solution or with some other similar drug, such as pantocaine. The pryriform aperture on the same side of the nose and the region surrounding the lacrimal sac are

injected with a 1 per cent novocaine solution, with a few drops of adrenalin added.

The incision is made along the pyriform aperture (see Fig. 3). The upper end of the incision is continued to a point corresponding to approximately the upper end of the lacrimal sac (see Fig. 3). The periosteum covering the outer nasal wall is elevated as far as the lacrimal sac. The nasal mucosa is also elevated so that the frontal process of the superior maxilla is completely freed from both sides. A nasal speculum is introduced so that the frontal process of the

Fig. 2. The bony lateral wall of right nasal cavity. Dotted line indicates position of lacrimal sac. Broken line indicates bone section which must be removed.

superior maxilla comes between the two blades of the instrument. The bone is removed with forceps and ronguers, beginning at the pyriform aperture in the direction of the lacrimal sac (see Fig. 4). The bone, especially near the sac, must be removed to a considerable degree to secure a good approach to the sac. It should be noted that the bone near the sac is very hard and thick, and must be removed with the aid of chisels and gouges; strong taps with a mallet or hammer are often necessary to do this. The lacrimal sac can easily be reached because one is always able to control the direction

of the gouge from the outside. The lacrimal sac can be properly located by means of a lacrimal probe passed by the canaliculus into it. Having located the sac, all the bone-covering should be removed from its frontal and mesial sides.

The shape of the defect in the lateral nasal wall resulting from the removal of bone is of great importance to the success of the operation. The object is to free the lacrimal sac from all surrounding bony walls. The shape of the opening

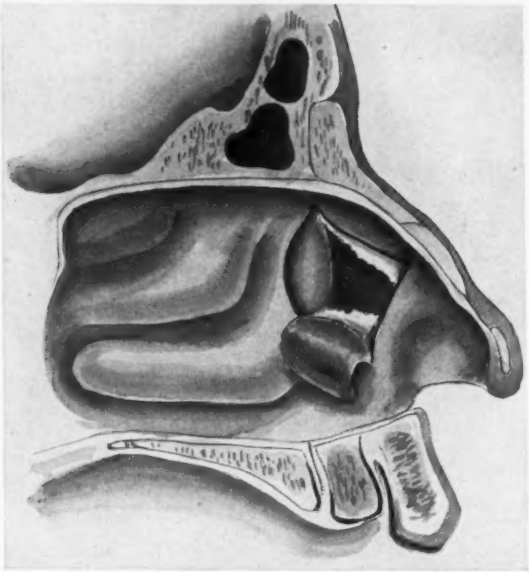

Fig. 3. The line indicates the initial operative incision along the pyriform aperture and continues to the upper part of lacrimal sac. The shaded portion indicates the removal of the mucous flap for drainage.

in the lateral wall is like that of a truncated triangle, the narrowest side beginning at the pyriform aperture and the widest coinciding with the line of the axis of the lacrimal sac. This removal of bone permits a sight of the lacrimal sac throughout its entire length (see Fig. 5), the easy and radical removal of the larger part of the wall, and reaches the widest communication between the lacrimal sac and the nasal cavity.

The removal of the larger part of the lacrimal sac is the main purpose of the operation, and on it depends the success

of the operation. As stressed in the very large number of articles on intranasal dacryocystorhinostomy, this operation presents a serious difficulty, the solution of which is by no means simple. In passing, the opinion of Meurman is of interest: "The most difficult phase of dacryocystorhinostomy is the cutting out of a sufficiently large flap of the medial

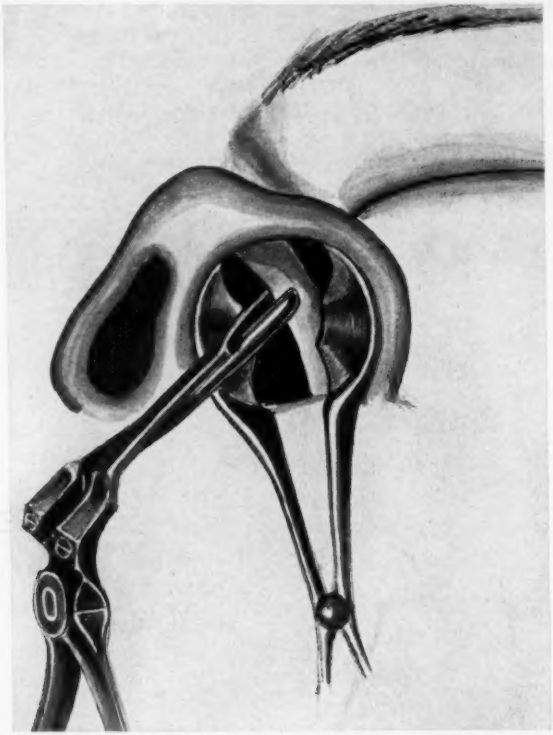

Fig. 4. The removal of the bone with gouge forceps, beginning from aperture in the direction of the lacrimal sac.

wall of the lacrimal sac in order to get a permanently large drainage hole for the tear fluid. If an incision only is made, one can be almost sure of consecutive atresia of the opening. This stoma has a peculiar tendency to diminish, probably mostly due to the activity of the periosteum at the frames of the window in the bony wall. It is, therefore, necessary to excise the largest possible flap of the medial sac wall."

The author agrees with the above opinion and endeavors to remove the medial and frontal walls of the lacrimal sac to their full length, thus rejecting the idea of the window resection. This goal is reached only when the bone lying in front of the lacrimal sac (frontal process of the superior maxilla and the lacrimal bone) is removed in a very radical manner so that the sac lies absolutely free. The sac is moved by means of a lacrimal probe passed by the caniculus and kept in position by an assistant. The inner wall is grasped at several points by one or two tenaculum forceps (constructed for seizing the lacrimal sac) and is cut with a very small sharp knife. In agreement with Kofler, the removal

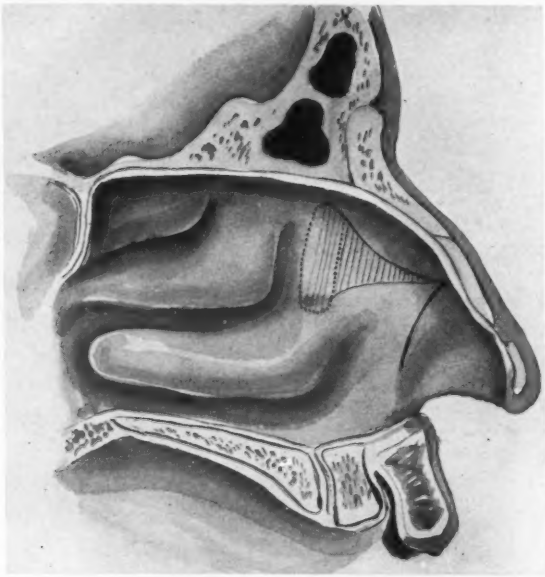

Fig. 5. A lateral view of the nasal cavity showing the situation after the resection of the ascending process of the superior maxilla. The lacrimal sac is completely free and easy to reach.

of the upper end is recommended as well. After removing the inner and front parts of the lacrimal sac, the nasal cavity is inspected and all abnormalities corrected. The anterior ethmoidal cells must be removed. If the anterior parts of the middle turbinate are hypertrophic, the interfering portions must also be removed. In any case, it is imperative that proper drainage into the nasal cavity be established. The

flap of the nasal mucosa must be adapted so that it can in no way cover the lateral wall of the lacrimal sac, and for this purpose the rear part of the mucous flap is cut away (see Fig. 3). The operation is completed by packing the anterior part of the nasal cavity lightly with gauze.

Two days after the operation the first change of dressing is made, when only a small strip of gauze to prevent the formation of synechia is introduced.

In the author's opinion, postoperative treatment must be of long duration. It is especially necessary to check the nasal cavity and to guard against unfavorable scar or synechia formation.

A SHORT ANALYSIS OF THE METHOD USED.

Intranasal dacryocystorhinostomy from a technical point of view presents various problems and every operator must have a clear understanding of the difficulties he is likely to meet. The author considers that the following points should receive great attention:

1. The position of the lacrimal sac in relation to the anatomical structure of the lateral wall of the nasal cavity is very uncertain, and in every dacryocystotomy case the approximate position of the lacrimal sac must be found and this dacryocystotomy is often very difficult. In this connection, external dacryocystotomy has its advantages, for it is nearly always possible to approach the sac without difficulty. Transapertural dacryocystotomy is favorable in that a canal is formed which permits the approach to the sac in every case. Even with the most unfavorable subjects, where the nasal cavity is small and the lacrimal sac deep-lying, it is reached in this manner with absolute ease.

2. The lacrimal sac must be freed as liberally as possible. The transapertural method liberates not only the medial but also the anterior wall of the lacrimal sac in a more radical way than other intranasal methods of dacryocystotomy.

3. The removal of parts of the lacrimal sac. This most difficult feature of dacryocystotomy can be accomplished in a more radical way with dacryocystotomy than with any other intranasal method. In transapertural dacryocystotomy it is possible to reject the window resection in favor of the resection of a great part of the lacrimal sac.

4. The establishment of a wide communication between the lacrimal sac and the nasal cavity can be established very easily by transapertural dacryocystotomy because all the bony wall dividing the lacrimal sac from the nasal cavity is completely removed.

5. A disadvantage of transapertural dacryocystotomy, however, is the fact that it is necessary to remove a considerable portion of the bone of the anterior parts of the lateral nasal wall. As the bone here is sometimes very hard, this complicates the operation. Many old intranasal dacryocystotomy methods are more delicate and are easier for patients to withstand.

The author's experience is based on 50 operations in the past 10 years and also on much special study of skulls and anatomical models. His conclusions are as follows: *1.* Results in all such cases were successful, the only complication being hemorrhage. *2.* The greatest difficulty was the removal of the thick bone around the lacrimal sac and the cutting of the flap from it. *3.* Forty per cent of the subjects operated on were out-patients who returned to their homes after the operation and came back two days later for the first change of dressing. *4.* All the operations were performed under local anesthesia. *5.* Ten per cent of the patients were over 65 years of age and all bore the operation well. *6.* Postoperative reaction was, on average, of from four to six days' duration. *7.* All the operations were performed with the assistance and under the observation of an ophthalmologist. *8.* The practical results of these operations can be expressed in the following words: Two of the first cases were not quite satisfactory, due primarily to insufficient experience on the part of the operator. In two cases there was a recurrence of tear-flowing due to the fact that it was not possible to make a large enough opening into the nose. In two more cases the direct results were good, but six months later there was a recurrence of tear-flowing due to scar formation and the narrowing in the proximity of the lacrimal sac. A recurrence of phlegmona of the lacrimal sac or of purulent discharge was not observed. It must be noted that for certain reasons not all the patients could be re-examined. If one considers the possibility that in some of the cases that were not subsequently seen there may have been a reappearance of tear-flowing, a figure of from 75 to 85 per cent can be assumed. This percentage, according

to Kofler,[11] compares favorably with the average of success in intranasal dacryocystotomy (Polyak,[12] 80 per cent; Faser,[12] 78 per cent; Whale Lawson,[12] 63 per cent; Bokstein,[12] 80 per cent; West,[12] 90 per cent; Kofler,[12] 100 per cent). *9.* Serious cases with recurrent phlegmonas of the lacrimal sac were suitable for this method and gave good results. *10.* The method could be used under the most unfavorable anatomical conditions. *11.* In no case where the lateral nasal wall was radically removed was there any external disfiguration.

CONCLUSONS.

The transparent dacryocystotomy, a little modified by the author, has the advantage that it is suitable for all cases, even when the conditions are most unfavorable and there is great alteration of the lacrimal sac. It allows a sure and easy approach to the lacrimal sac and permits a wide drainage into the nasal cavity but involves a very radical bone removal.

Technique: By means of an incision along the border of the pyriform aperture, the frontal process of the superior maxilla is freed on both sides in the direction of the lacrimal sac. All the bone from the pyriform aperture to the lacrimal sac is removed to such an extent that the sac throughout its entire length is completely freed. The greater part of the lacrimal sac is removed so that wide drainage is established.

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THE RELATION OF DENTAL DISEASE TO SINUSITIS.*

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Anatomically the upper posterior teeth, from the bicuspids back, are in close proximity to the antra. In many cases one or more roots of these teeth actually penetrate the floor of the antrum (see Fig. 1). From a pathological standpoint the authors have noticed numerous cases in which there is a marked thickening of the sinus membrane over roots of diseased teeth (see Fig. 2). This finding led us to investigate the possibility of primarily infected teeth giving rise secondarily to antral infections. It was found in the study of some 200 cases that the same bacteria were present in the antra as were present in the teeth themselves. Discharges from other sinuses also contained the same bacteria which were found in the teeth. This fact is logical because the discharge from an antrum can easily find its way around the openings of the sphenoids, ethmoids and frontals. In edentulous patients in whom the roots of the teeth are not in the antra, the organisms were cultured from the alveolar processes in close relation to the floor of the antrum. Microscopic section of this bone showed many organisms present (see Fig. 3).

With the aforementioned facts in mind, we started to remove surgically the infected teeth and surrounding alveolus in cases of chronic sinusitis.[1] In all our cases we remove the entire floor of the antrum and curette the membrane (see Fig. 4). This incision is not sutured but left open to drain. The antra are irrigated daily with hypertonic saline and the wound gradually granulates closed. This process takes about three weeks to a month. We encounter no difficulty in getting the wound to close completely (see Fig. 4). In fact, if a small sinus persists we feel that some infection remains, and a more radical procedure is done.[2]

After the antral infection is cleared up, the other sinus

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infection usually responds well to a few Proetz treatments followed by nasal douches twice a day with hypertonic saline.

DISCUSSION.

The rationale of this form of therapy lies in the fact that the source of the offending organism is eradicated. The

Fig. 1. The second bicuspid penetrates the bony floor of the antrum. The roots of the molars closely approximate the lateral antral walls.

Fig. 2. Shows marked thickening of the antral membrane directly over diseased teeth and diseased alveolar process. The antrum contained almost one ounce of free pus when opened.

authors feel that they have logically shown that organisms from the teeth and alveolar processes can and do produce sinus infections. This type of operation is ideal for drainage

of the antra because the opening is at the bottom. In this respect it is better than the recognized Caldwell-Luc opera-

Fig. 3. Photomicrograph of root tip and alveolar process showing necrotic bone and organisms stained within the bone. This tooth contains a large pulp stone.

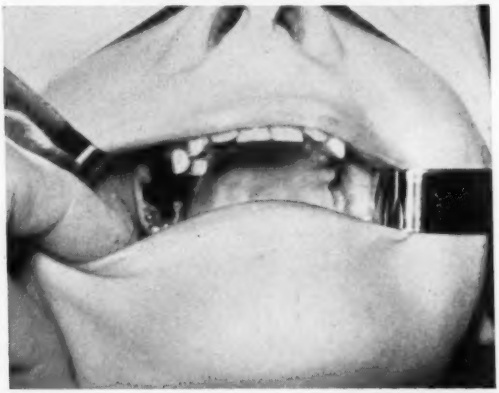

Fig. 4. Demonstrating the opening into the antrum immediately after the operation on the patient's right side. On the patient's left, a similar operation is well healed three weeks postoperatively.

tion. This procedure is simple and is not accompanied by as many complications as are other surgical procedures. Hemor-

rhage is infrequent and is easily controlled by packing. Secondary infection has not been encountered in our series of 200 cases.

CONCLUSIONS.

1. The relation of dental infections to sinus infections is shown.

2. An operative technique for the eradication of the primary infection is discussed.

3. This method of handling the chronic sinusitis patient has proven far superior to any of the recognized forms of therapy in some 200 cases.

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